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Fish and amphibian communities in backwaters of the River Danube near Vienna

by
R. Spolwind and M. Pintar
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Abstract: Fish and amphibian communities were investigated in a floodplain area of the river Danube near Vienna in the years 1993 and 1994. Several backwater types were distinguished, typical fish- and amphibian communities are described. The importance of habitat structure for the coexistence of both groups is discussed, the results are compared with recent publications.
Key words: Pisces, Amphibia, Danube, backwater-types, fish and amphibian community

Introduction

The fish and amphibian fauna is an important part of the vertebrate fauna of the Danube backwaters. In many cases fish are important top predators of the aquatic system, amphibians (larvae and in many cases adults) are also important parts of several aquatic trophic levels. A faunistical investigation of both groups due to the construction of a hydroelectric station near Vienna took place in the years of 1993 and 1994 and delivered new data about fish and amphibian associations.

Most recent publications dealing with fish and amphibians are mostly restricted to a more detailed investigation of one group (Müller 1968, Flindt & Hemmer 1969, Broggi 1975, Filoda 1981, Clausnitzer 1983 a, b, Gebhardt 1985, Hehmann & Zucchi 1985, Bauser *et al.* 1987, Dolmen 1987, Amtkjaer 1988, Holmen & Wederkinch 1988, Schay 1988, Bradford 1989, Breuer 1992, Banks *et al.* 1993, Sound & Veith 1994). In our case we had the ability to investigate both groups on a similar level.

All Austrian amphibian species are on the Austrian Red List of Threatened Animals (Gepp 1983), amphibians are important bioindicators of wetland ecotones. Also many of the recorded fish species that are typical for floodplain ecosystems are on the Red List because of massive anthropological disturbances of ecological factors of these systems in the last hundred years. Especially species migrating between the main channel and backwaters, such as species of the group rheophilic b (*Abramis ballerus, Abramis sapa*, Schiemer & Waidbacher 1992) and limnophilic species are endangered.

Materials and methods

Study Area

The study area is a riparian forest of the River Danube west of Vienna (Klosterneuburg). In spite of riverbed regulations beginning in the end of the last century the area still shows dynamic characteristics such as periodical floods and oscillating subsoil water. Due to

dynamic conditions in floodplains fish and amphibian communities in backwater systems are often adapted to periodical floods in certain ways. Some fish species show characteristic migrating behaviour between main channel and backwaters, the structure of fish communities in backwaters sometimes seems to have stochastical character because of stochastical occurrence and duration of floods (Waidbacher 1989, Zauner & Jungwirth 1994). Amphibians in backwaters often show different behavior about mating time and lifelong fidelity to a spawning site (Pintar 1979, 1984, Pintar & Straka 1990, Kuhn 1993).

Backwater Habitat Types

Due to Pintar & Waringer-Löschenkohl (1990) and based on the investigation of morphological and hydrological parameters the following backwater types are described:

- permanent backwaters: no direct connection with the river, permanently filled with water, – with dense macrophyte growth and often large inundation areas.
- temporary backwaters: also no direct connection with the river, only temporarily filled with water, many different types due to their size, structure, choriotopes, vegetation and shade.
- flowing backwaters: in our case a human-influenced habitat type with mostly flowing water characteristics.

We studied 30 different backwaters in the investigation area. 6 of of them (20 %) had a permanent character, 17 (57%) a more temporary state. 7 backwaters (23%) were flow-water habitats.

Methods

In the years 1993 and 1994 all aquatic habitats were mapped and investigated several times to make sure to get a complete data set of both vertebrate groups.

All potential amphibian spawning habitats were controlled several times per season (March-August) to indicate all of the fish and amphibian species in different life stages. To indicate successful amphibian reproduction, we counted spawning clutches (especially *Rana dalmatina*) and searched habitats for larvae and recent metamorphosed juveniles. Larval occurrence was identified by standardised catches with a hoop net.

Fish communities were primaly investigated by electrofishing. Fish show characteristic galvanotaxis in an electric field (Cowx & Lamarque 1990). Because of several physiological processes, the field-influenced specimen swims actively to the anode and is narcotized there. We used 1,5 or 2,5 KW aggregates (DC) with 300-600 Voltage. The caught individuals were determined, measured and afterwards set back.

In some cases amphibians also show characteristic galvanotaxis, such individuals were also taken in our data set. We believe that the method of electrofishing in the case of amphibian-mapping is not efficient enough to quantify data comparable to fish. Caudata (larvae and adults) and larvae of anurans showed galvanotaxis in some cases, adult anurans were just narcotized but did not swim actively to the anode.

Results and discussion

Fig. 1 shows an overview of different colonization of both groups in different backwater types. It is obvious that a rich diversity of backwater types is important for successful reproduction of both groups. In the following tables all recorded species as well as their frequency in the three defined backwater types are shown (Tables 1,2).

Table 1. Frequency of investigated fish species and their occurrence in the different backwater types. 1:number of spawning sites, 2: frequency in %, 3: spawning sites in permanen backwaters (%), 4: spawning sites in temporary backwaters (%), 5: spawning sites in flowing backwaters (%)

Species	1	2	3	4	5
Chondrostoma nasus	4	13		25	75
Barbus barbus	1	3			100
Leuciscus leuciscus	3	10			100
Leuciscus cephalus	3	10			100
Leuciscus idus	1	3	100		
Abramis sapa	1	3	100		
Abramis ballerus	1	3	100		
Aspius aspius	3	10	33		77
Lota lota	2	7	50		50
Esox lucius	9	30	44,4	33,3	22,2
Rutilus rutilus	6	20	33,3	33,3	33,3
Alburnus alburnus	5	17	20	40	40
Blicca björkna	8	27	25	37,5	37,5
Abramis brama	5	17	20	40	40
Carassius auratus gibelio	2	7	50		50
Perca fluviatilis	4	13	50		50
Stizostedion lucioperca	1	3		100	
Proterorhinus marmoratus	5	17	60		40
Cyprinus carpio	2	7	100		
Scardinius erythrophthalmus	1	3	100		
Rhodeus sericeus amarus	2	7	50	50	
Tinca tinca	4	13	75	25	
Misgurnus fossilis	3	10	100		

It is obvious that characteristic backwater fish communities only occur in permanent waterbodies with greater extention. The greatest number of fish species was found in a permanent backwater with a less isolated status, species of a more rheophilic character (such as *Abramis ballerus, Abramis sapa, Lota lota* and *Aspius aspius*) were associated with typical, dominant eurytopic species (e.g. *Rutilus rutilus, Perca fluviatilis, Esox lucius*) as well as with stagnophil forms (e.g. *Misgurnus fossilis*).

Rheophilic species (mostly juveniles) could be found in flowing water habitats, *Chondrostoma nasus, Leuciscus cephalus, Leuciscus leuciscus* as well as *Aspius aspius* were detected, no amphibians at all were found in lotic habitats.

Isolated, permanent backwaters show typical eurytopic-limnophil fish associations with lower species numbers and typical species peaks in eurytopic categories (e.g. dominance of

Carassius auratus gibelio or *Rutilus rutilus*), sometimes stagnophil species as *Misgurnus fossilis* occur in greater percentage. *Esox lucius* is the dominant predator in nearly all backwaters with fish associations.

Habitats with more extreme limnochemical or hydrological conditions show sometimes fluctuating and stochastical (flood determined) fish communities. For example in some permanent waterbodies populations with only *Esox lucius* occur. In one temporary backwater near the Danube a few individuals of adult *Chondrostoma nasus* as well as *Stizostedion lucioperca* were found, both populations were extincted.

Table 2. Frequency of investigated amphibian species and their occurrence in the different backwater types. 1: number of spawning sites, 2: frequency in %, 3: spawning sites in permanent backwaters (%), 4: spawning sites in temporary backwaters (%), 5: spawning sites in flowing backwaters (%)

Species	1	2	3	4	5
Triturus vulgaris	16	53	25	69	6
Triturus dobrogicus	13	43	31	69	
Bombina bombina	14	47	29	71	
Pelobates fuscus	4	13	25	75	
Bufo bufo	4	13	75	25	
Hyla arborea	13	43	23	77	
Rana dalmatina	21	70	24	71	5
R. esculenta, R. ridibunda	12	40	25	75	

Habitats with a greater number of amphibian species could be distinguished in several types. On one hand a pond with little ecomorphological differentiation but without permanent fish-colonization showed maximal species number (all species except *Pelobates fuscus*), on the other hand one backwater with remarkable fish biomass but extensive inundation areas was also a very valuable spawning habitat of amphibians. Permanent backwaters with greater fish biomass and a lack of shallow-water areas with macrophytes show the missing of potential fish-sensitive ampibians such as *Hyla arborea* and *Triturus vulgaris* (Hehmann & Zucchi 1985, Fog 1988).

The most common species was *Rana dalmatina*, the number of clutches of *Rana dalmatina* per habitat showed significant correlation with fish-colonization. (Significantly greater amount of clutches in habitats without permanent fish-colonization). *Rana dalmatina* spawns in permanent as well as in temporay backwaters. *Bufo bufo* showes no correlation with fish-colonization (Breuer 1992). *Bufo bufo* favoured permanent habitats in a significant way.

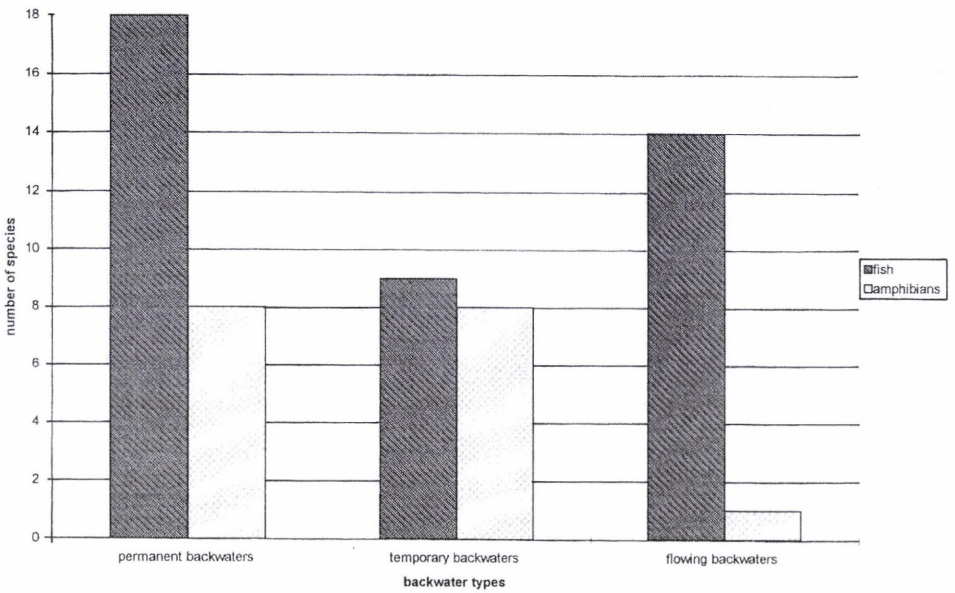

Fig.1. Number of fish- and amphibian species in the different backwater types

Flowing water influenced habitats exhibit no amphibians at all, this should be caused more by the flowing water characteristic (no potential spawning habitat for amphibian species of flood plains) than by rheophilic fish species as potential predators of amphibians.

In our investigation fish and amphibians are therefore *a priori* not excluded. Some species such as *Bufo bufo* seem to be posetively correlated with fish in many investigations (Hehmann & Zucchi 1985, Clausnitzer 1983 a, b, Filoda 1981, Breuer 1992, Kwet 1996) in our study the sample in the case of *Bufo bufo* is too small for valid conclusions. *Rana dalmatina* as the most common species accepts permanent as well as temporary backwaters, significant correlations toward fish occurrence are remarkable. *Triturus vulgaris* is also common in the study area and occurs in more than half of the investigated habitats. Poorly structured and shaded backwaters are tolerated as spawning sites (Pintar & Straka, 1990). *Pelobates fuscus* as a pioneer species seems to prefer more dynamic areas or pioneer backwater habitats (astatic backwaters occurring after floods), in our study *Pelobates fuscus* seems to be sensitive towards fish occurrence, we did not find any larvae of this species in habitats with permanent fish-colonization.

Ecomorphologically highly structured habitats with great macrophyte biomass and shallow-water areas are essential for a combined occurrence of fish and amphibians; in less structured habitats predator effects affect mostly sensitive species, massive fish introduction affect amphibian biomass as well as number of species ((Flindt & Hemmer 1969, Durrer 1992). Not only carnivore species as pike or trout but also many omnivore fishspecies are potential predators of eggs, larvae and adults of amphibians (Breuer 1992, Clausnitzer 1983b). This has to be mentioned when e.g. human build habitats ("second hand habitats") are colonised with fish by man. Inaccessible shallow water areas as spawning sites for amphibians are indispensable for coexistence of both groups.

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References

Amtkjaer, J. (1988): Monitoring populations of the green toad (*Bufo viridis* Laur.) on the island of Samso. – *Memoranda Soc. Fauna Flora Fennica* **64**: 129-132.

Banks, B., Beebee, T.J.C. & Denton, J.S. (1993): Long-term management of a natterjack toad (*Bufo calamita*) population in southern Britain. – *Amphibia-Reptilia* **14**: 155-168.

Bauser, A., Waibel, A., Hollnaicher, M. & Rahmann, H. (1987): Populationsdynamische Untersuchung der Amphibienfauna stehender Gewässer mit unterschiedlicher fischereilicher Nutzung in Oberschwaben. – *Ökologie & Naturschutz* **1**: 95-116.

Bradford, D.F. (1989): Allotopic distribution of native frogs and introduced fishes in High Sierra Nevada lakes of California: implication of the negative effect of fish introductions. – *Copeia* **3**: 775-778.

Breuer, P. (1992): Amphibien und Fische – Ergebnisse experimenteller Freilanduntersuchungen. – *Fauna Flora Rheinland-Pfalz*, Beiheft **6**: 117-133.

Broggi, M. (1975): Amphibien und Fischbesatz in Kleingewässern. – *Ber. Bot.-Zool. Ges. Liechtenstein* **75**: 53-57.

Clausnitzer, H.J. (1983a): Zum gemeinsamen Vorkommen von Amphibien und Fischen. – *Salamandra* **19**: 158-162.

Clausnitzer, H.J. (1983b): Der Einfluß unterschiedlicher Bewirtschaftungsmaßnahmen auf den Artenbestand eines Teiches. – *Natur u. Landschaft* **58**: 129-133.

Cowx, I.G. & Lamarque, P. (1990): *Fishing with Electricity*. Fishing New Books. Oxford, 248 p.

Dolmen, D. (1987): Hazards to Norwegian amphibians. In: van Gelder, J.J., Strijbosch, H. & Bergers, P.J.M. (eds): Proc. Fourth Ord. Meet. S.E.H. Nijmegen, p. 119-122.

Durrer, H. (1992): Die Auenlandschaft des Rheins unterhalb von Basel. – *Verh. Naturf. Ges Basel* **102**: 297-310.

Filoda, H. (1981): Das Vorkommen von Amphibien in Fischgewässern des östlichsten Teils Lüchow-Dannenbergs. – *Beitr. Naturk. Niedersachs.* **34**: 185-189.

Flindt, R. & Hemmer, H. (1969): Gefahr für Froschlurche durch ausgesetzte Sonnenbarsche. – *DATZ*, Stuttgart **22**: 24-25.

Fog, K. (1988): An investigation of all ponds with *Hyla arborea* on the Island of Als, DK. II. Statistical treatment of results. – *Memoranda Soc. Fauna Flora Fennica* **64**: 122-123.

Gebhardt, H. (1985): Fische und Amphibien. – *Tag.-Ber. Naturschutz Bad.-Württ.* **7**:34-40.

Gepp, J. (1983): *Rote Liste gefährdeter Tiere Österreichs*. BMfUG. Wien. 242 pp.

Hehmann, F. & Zucchi, F. (1985): Fischteiche und Amphibien – eine Feldstudie. – *Natur u. Landschaft* **60**: 402-408.

Holmen, M. & Wederkinch, E. (1988): Monitoring amphibian populations in the Copenhagen region. – *Memoranda Soc. Fauna Flora Fennica* **64**: 124-128.

Kuhn, J. (1993): Fortpflanzungsbiologie der Erdkröte *Bufo b. bufo* (L.) in einer Wildflußaue. – *Z. Ökologie u. Naturschutz* **2**: 1-10.

Kwet, A. (1996): Zu den natürlichen Feinden des Laichs von Froschlurchen. – *Salamandra* **32**: 31-44.

Müller, P. (1968): Amphibien und Fischbesatz. – *Naturforsch. Ges. Schaffhausen: Flugbl.-Ser. II*, Nr. **3**:12-13.

Pintar, M. (1979): *Ökologische Zusammenhänge von Au-Standorten, Sukzession auf Schlägen und Anuren im Gebiet von Stockerau (NÖ).* Diss. Univ. Wien, 164 S.

Pintar, M. (1984): Der Einfluß von Hochwässern auf die Anurenbesiedlung von Lebensräumen der Donau-Auen bei Wien. – *Salamandra* **20**: 229-232.

Pintar, M. & Waringer-Löschenkohl, A. (1990): Faunistisch-ökologische Erhebungen der Amphibienfauna in den Augebieten der Wachau. – *Verh. Zool. Bot. Ges. Österreich* **126**: 77-96.

Pintar, M. & Straka, U. (1990): Beitrag zur Kenntnis der Amphibienfauna der Donau-Auen im Tullner Feld und Wiener Becken. – *Verh. Zool. Bot. Ges. Österreich* **127**:123-146.

Schay, G. (1988): Untersuchungen zur Frage der Überlebensrate von Embryonen und Larven des Grasfrosches (*Rana temporaria temporaria* L.) in fischfreien und fischbesetzten Laichgewässern. Diss. Univ. Wien, 86 p.

Schiemer, F. & Waidbacher, H. (1992): Strategies of Conservation of a Danube Fishfauna. In: Boon P.J., Calow, P. & Pets, G.E. (eds)*: River Conservation and Management.* John Wiley & Sons, Ltd. p. 363-382.

Sound, P. & Veith, M. (1994): Zum Vorkommen der Larven des Feuersalamanders (*Salamandra salamandra salamandra/terrestris*) in Abhängigkeit von der Forellendichte sowie einiger abiotischer Faktoren. – *Zeitschrift für Feldherpetologie* **1**: 89-101.

Waidbacher, H. (1989): Fischökologische Untersuchung im Donauraum östlich von Wien. ISD, Projektstudie im Auftrag des Österreichischen Wasserwirtschaftsverbandes, 149-182. Eigenverlag.

Zauner, G. & Jungwirth, M. (1994): Fischökologische Untersuchung, Schlußbericht im Rahmen der Gesamtuntersuchung Salzach (GWS); im Auftrag des Amts der Salzburger Landesregierung und des BMfLF. Herausgeber: ÖIR 137 pp.

Authors' addresses: Robert Spolwind,
Institute for Water Provision,
Water Ecology and Waste Management, Dept. of Hydrobiology, Fisheries and Aquaculture,
University of Agricultural Sciences,
Max-Emanuel-Strasse 17,
A-1180 Wien, Austria
E-mail: spolwind@edv1.boku.ac.at

Dr. Manfred Pintar,
Institute for Zoology,
University of Agricultural Sciences,
Gregor-Mendel-Strasse 33,
A-1180 Wien, Austria
E-mail:
pintar@edv1.boku.ac.at